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Asymmetric Competitive Sorption of Arsenic and Fluoride on Iron-Based Adsorbents under Neutral pH Mine Drainage

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Arsenic (As) and fluoride (F) are contaminants in mine drainage and can pose risks to human health and environment at low concentrations. The coexistence of As and F has been reported in aquatic system near mining areas in South Korea ([1]). The As and F predominantly occur as oxyanions under neutral pH; hence, they showed similar geochemical behaviors. They compete for the same adsorption site that induce complicates of simultaneous removal from mine drainage. Therefore, understanding the competitive adsorption of As and F is necessary for effective remediation of mine drainage by adsorption processes. Single and competitive adsorption of As and F were investigated under neutral pH using two iron-based adsorbents: MIRESORB (iron oxide) and GFH (iron hydroxide). Adsorption isotherm, kinetic and desorption experiments were conducted, and FTIR analysis identified surface functional groups involved in As and F adsorption. The As and F competed for partially shared functional groups on the MIRESORB, resulting in mutual suppression of adsorption. In contrast, GFH showed a higher affinity for As than F, which inhibited F adsorption. These results indicated that GFH provides a broader range of functional groups in As adsorption, leading to asymmetric adsorption of As and F. In addition, guidance for adsorbent selection suggested to achieve mine drainage treatment.

[1] Choi, S. G., Pak, S. J., Lee, P. K., & Kim, C. S. (2004). An overview of geoenvironmental implications of mineral deposits in Korea.